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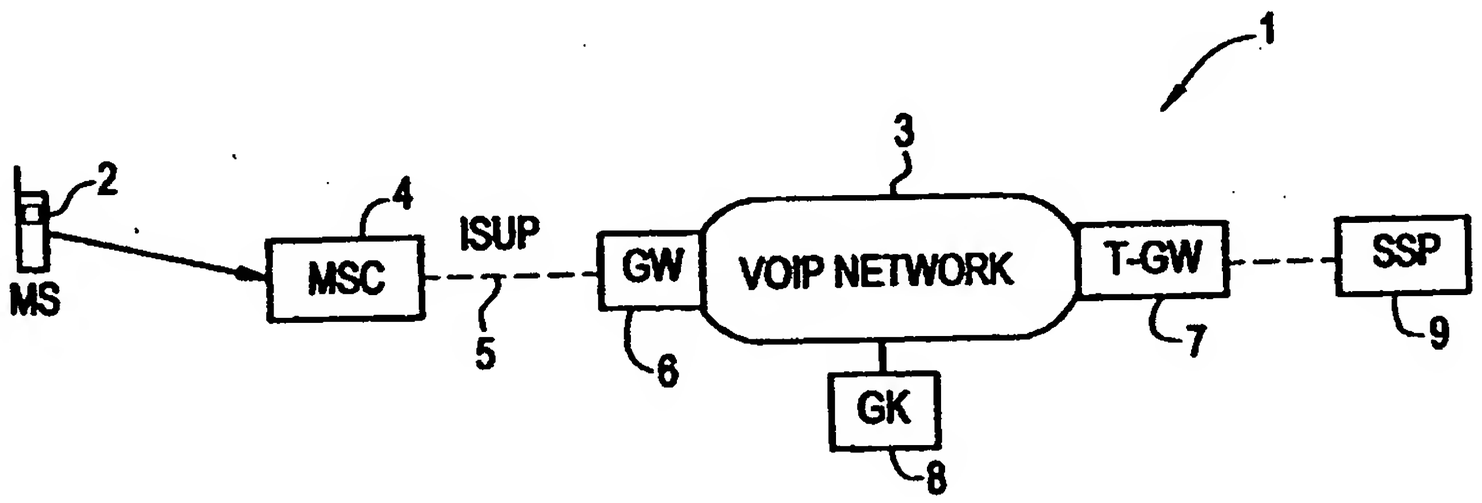
(54) Title: SYSTEM AND METHOD OF PROVIDING A REQUIRED QUALITY OF SERVICE (QOS) LEVEL FOR A MOBILE-ORIGINATED CALL ROUTED THROUGH A PACKET-SWITCHED NETWORK



(57) Abstract: A system and method of providing a required quality of sercice (QOS) level for a call that is originated in a mobile radio telecommmnications network and is routed through a Voice-Over-Internet-Protocol (VOIP) network(3). Signaling connections are established between a mobile switching center (MSC) (4) in the mobile network and at least one VOIP gateway (6). The MSC sends an Initial Address Message (IAM) (11) to the VOIP gateway and includes a new QOS Required parameter (12). The gateway confers with a gate keeper (8) in the VOIP network to determine whether the required QOS can be provided. If the required QOS can be provided, an indication that the required QOS can be provided is sent from the packet-switched network to the mobile network. If the required QOS cannot be provided, an indication (16) that the required QOS cannot be provided is sent from the packet-switched network to the mobile network.

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SYSTEM AND METHOD OF PROVIDING A REQUIRED QUALITY OF SERVICE (QOS) LEVEL FOR A MOBILE-ORIGINATED CALL ROUTED THROUGH A PACKET-SWITCHED NETWORK

BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to telecommunication systems and, more particularly, to a system and method of providing a required quality of service (QOS) level for a mobile-originated call that is routed through a packet-switched network.

Description of Related Art

There are existing or proposed network architectures for routing calls originated by a mobile station (MS) in a radio telecommunications network (i.e., MS-originated calls) through a packet-switched network such as a Voice-Over-Internet-Protocol (VOIP) network. In these architectures, the call is set up utilizing Integrated Services User Part (ISUP) signaling between a mobile switching center (MSC) in the mobile network and a VOIP Gateway which provides an interface into the VOIP network. The current ISUP interaction between the MSC and the Gateway, however, does not provide for any negotiation of a level of quality of service (QOS) required by the mobile network. Since there is currently no negotiation, the mobile network must take whatever QOS is provided by the VOIP network.

Today, mobile networks generally have lower QOS than wireline networks due to limitations of the air interface. For long distance calls, mobile calls are transported to the Public Switched Telephone Network (PSTN) which is a circuit-switched network in order to maintain the QOS. If mobile calls are to be routed through a VOIP network, a QOS guarantee is needed to ensure the QOS does not degrade below an acceptable level. The current interaction between the MSC and the VOIP Gateway does not guarantee QOS for the call.

There are no known prior art teachings of a solution to the aforementioned deficiency and shortcoming such as that disclosed herein. In order to overcome the

disadvantage of existing solutions, it would be advantageous to have a system and method of providing a required quality of service (QOS) level for a mobile-originated call that is routed through a packet-switched network. In addition, such a system should provide a more robust network architecture. The present invention provides such a system and method.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a system for providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network. The system comprises a mobile switching center that sends an indication of the required QOS from the mobile network to the packet-switched network, means within the packet-switched network for determining whether the required QOS can be provided, and a gateway in the packet-switched network that sends an indication to the mobile network of whether the required QOS can be provided.

In another aspect, the present invention is a method of providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network. The method comprises the steps of sending an indication of the required QOS from the mobile network to the packet-switched network, determining in the packet-switched network whether the required QOS can be provided, and sending an indication that the required QOS can be provided from the packet-switched network to the mobile network, upon determining that the required QOS can be provided. The method may also include sending an indication that the required QOS cannot be provided from the packet-switched network to the mobile network, upon determining that the required QOS cannot be provided. The indication may also provide the QOS level that is available.

In another aspect, the present invention is a method of providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network when the mobile switching center (MSC) is connected to a plurality of packet-switched

networks. The MSC may simultaneously send an indication of the required QOS from the mobile network to each of the plurality of packet-switched networks. Each packet-switched network then determines whether it can provide the required QOS, and sends an indication of whether the required QOS can be provided to the MSC. Alternatively, the MSC may sequentially query the packet-switching networks to determine the QOS available. This is followed by determining in the MSC whether any of the packet-switched networks can provide the required QOS, and selecting by the MSC, one of the plurality of packet-switched networks to route the call, upon determining that at least one of the packet-switched networks can provide the required QOS.

In yet another aspect, the present invention is a method of accessing a packet-switched network from a mobile radio telecommunications network having an MSC. The method includes the steps of establishing a plurality of signaling connections between the MSC and a plurality of packet-switched networks, and sending a plurality of access messages from the MSC to the plurality of packet-switched networks. This is followed by sending an access response message from each of the plurality of packet-switched networks to the MSC, and selecting one of the responding packet-switched networks for access.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

FIG. 1 is a simplified block diagram of a network architecture in which the method of the present invention may be practiced in order to provide a required QOS level for a MS-originated call routed through a Voice-Over-Internet-Protocol (VOIP) network;

FIG. 2 is a sequence diagram illustrating the flow of messages between the MSC and the VOIP Gateway of FIG. 1 for a MS-originated call which is routed through the VOIP network;

FIG. 3 is a simplified block diagram of the preferred embodiment of an architecture for routing a MS-originated call through a VOIP network and for

providing a required QOS level for the call;

FIG. 4 is a sequence diagram illustrating the flow of messages for routing a MS-originated call through a VOIP network when the MSC is connected to more than one VOIP Gateway; and

FIG. 5 is a sequence diagram illustrating the flow of messages for routing a MS-originated call when the required QOS cannot be provided by any VOIP network.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention is a system and method of providing a required quality of service (QOS) level for calls that are routed through a packet-switched network such as a Voice-Over-Internet-Protocol (VOIP) network, Asynchronous Transfer Mode (ATM) network, etc. The invention is primarily applicable to calls originated by a mobile station (MS) in a radio telecommunications network (i.e., MS-originated calls). In addition, the invention provides a more robust network architecture than architectures that have currently been proposed.

FIG. 1 is a simplified block diagram of a network architecture 1 in which the method of the present invention may be practiced in order to provide a required QOS level for a call originated by a mobile station (MS) 2 which is routed through a VOIP network 3. An MSC 4 utilizes Integrated Services User Part (ISUP) messages to set up a connection 5 with a VOIP Gateway (GW) 6. The destination in the VOIP network is a Terminating Gateway (T-GW) 7. A Gate Keeper (GK) 8 maintains an overall status of the VOIP network regarding latency delays, congestion, etc. Calls which are successfully routed through the VOIP network are sent from the T-GW to a Service Switching Point (SSP) 9 for further routing.

FIG. 2 is a sequence diagram illustrating the flow of messages between the MSC 4 and the VOIP Gateway 6 of FIG. 1 for a MS-originated call which is routed through the VOIP network 3. An ISUP Initial Address Message (IAM) 11 is sent from the MSC to the Gateway with a newly defined QOS Required parameter 12. The QOS Required parameter specifies performance levels which impact QOS such as, for example, the number of router hops allowed in the VOIP network 3, the bandwidth required, and/or the latency in terms of time allowed for packet transport to the T-GW

7. The Gateway may confer with the Gate Keeper 8 utilizing procedures outlined in H.323 to determine whether it is possible to provide the QOS required. This determination is based on the MDN provided in the IAM message which determines the T-GW at the destination end of the network. The Gateway sends an Admission Request (ARQ) message 13 to the Gate Keeper which makes its QOS determination and returns an Admission Confirmation (ACF) message 14 to the Gateway.

Table 1 below illustrates the use of the QOS Required parameter in the ISUP Initial Address Message (IAM).

ISUP Initial Address Message (IAM)		
The QOS Required parameter is sent as an optional parameter in the following format:		
QOS Required	Value	Comments
Optional Parameter Code	Set to any suitable value	
Optional Parameter Length Indicator		Indicates the total number of octets required for Request for Delay in milliseconds (latency), Request for Number of router hops, and Request for Available Bandwidth
Optional Parameter Octets		Request for Delay in milliseconds (latency), Request for Number of router hops, and Request for Available Bandwidth

Table 1

After the QOS determination is made, the Gateway 6 sends an ISUP Address Complete Message (ACM) 15 to the MSC 4 and includes a QOS Available parameter 16 that indicates the QOS level that the VOIP network can provide, and thus indicates whether the VOIP network can satisfy the demanded quality of service (QOS Required). If the QOS Required can be supported, the call is routed to the Gateway, through the VOIP network 3, and to the SSP 9.

Table 2 below illustrates the use of the QOS Available parameter in the ISUP Address Complete Message (ACM).

ISUP Address Complete Message (ACM)		
The QOS Available parameter is sent as an optional parameter in the following format:		
QOS Available	Value	Comments
Optional Parameter Code	Set to any suitable value	
Optional Parameter Length Indicator		Indicates the total number of octets required for Delay in milliseconds (latency), Number of router hops, and Available Bandwidth
Optional Parameter Octets		Delay in milliseconds (latency), Number of router hops, and Available Bandwidth

Table 2

Some applications require more bandwidth in the VOIP network than others, and at any one time, several applications may compete for available bandwidth. The mobile call must have sufficient bandwidth allocated to it to ensure the required QOS is provided. If the mobile call also has data or graphics associated with it, the VOIP network may indicate an available bandwidth that is sufficient for voice only. The MSC may then attempt to route the call through another VOIP network or the PSTN, or may provide an announcement to the calling subscriber informing him/her that only resources for voice calls are available.

FIG. 3 is a simplified block diagram of the preferred embodiment of an architecture 20 for routing a MS-originated call through a VOIP network and for providing a required QOS level for the call. In the preferred embodiment, the MSC 4 utilizes a plurality of ISUP connections 21 to communicate with a plurality of VOIP Gateways 22-25. There may be multiple Gateways for each VOIP network, and there may be multiple VOIP networks involved in the architecture. In actual practice, such a configuration may occur when the MSC is operated by a local carrier, and the VOIP networks are operated by competing long distance carriers.

In the example illustrated in FIG. 3, Gateway-1A (22) and Gateway-1B (23) are connected to VOIP Network-1 (26), and Gateway-2A (24) and Gateway-2B (25)

are connected to VOIP Network-2 (27). At the terminating side of VOIP Network-1 is a Terminating Gateway-1 (T-GW-1) 28. A Gate Keeper-1 (GK-1) 29 is also part of VOIP Network-1. At the terminating side of VOIP Network-2 is a Terminating Gateway-2 (T-GW-2) 31. A Gate Keeper-2 (GK-2) 32 is also part of VOIP Network-2. Calls transported by either VOIP Network-1 or VOIP Network-2 are routed to the SSP 9.

By connecting the MSC 4 to many Gateways 22-25, a more robust architecture is provided. Currently conceived architectures use only a single Gateway; however, a single Gateway may fail, thus leaving the radio network with no access to a VOIP network. Multiple Gateways provide redundancy and a path for accessing a VOIP network even if one of the Gateways fails.

FIG. 4 is a sequence diagram illustrating the flow of messages for routing a MS-originated call through a VOIP network when the MSC 4 is connected to more than one VOIP Gateway and to one or more VOIP networks. For illustrative purposes, the MSC is illustrated as being connected to Gateway-1A (22), Gateway-2A (24), and a plurality of other Gateways including Gateway-N (33). In this configuration, the MSC may send ISUP messages to many gateways in one or more VOIP networks. The call, therefore, is more likely to be successfully set up with the required QOS.

The MSC 4 sends a plurality of IAM messages 34-36, one to each of the connected Gateways. The IAM messages each include the QOS Required parameter 12, and may be sent either simultaneously or sequentially to each of the Gateways, as long as the call setup time is not exceeded. If the IAM messages are sent sequentially, the MSC may have a preferred Gateway which is always tried first.

As shown above in FIG. 2, each of the Gateways may then confer with a Gate Keeper associated with the VOIP network to which the Gateway is connected to determine the level of QOS which can be provided. When the QOS determination is made, each Gateway returns an ACM message to the MSC 4 and includes the QOS Available parameter 16. The QOS Available parameter indicates the QOS level that the VOIP network can provide, and thus indicates whether the VOIP network can satisfy the demanded quality of service (QOS Required).

The call may then be routed in one of several alternative ways. First, the MSC

may route the call to the first Gateway that sends an ACM message with a QOS Available which meets or exceeds the QOS Required. Second, the MSC may collect responses for a predetermined time period and then route the call to the Gateway which reported the best QOS Available.

FIG. 5 is a sequence diagram illustrating the flow of messages for routing a MS-originated call when the required QOS cannot be provided by any VOIP network. Initially, the procedure is the same as that illustrated in FIG. 4. The MSC 4 sends a plurality of IAM messages 41-43, one to each of the connected Gateways, and includes the QOS Required parameter in each message. Each VOIP network then determines whether or not it can provide the required QOS. Each Gateway then returns an ACM message to the MSC 4 and includes the QOS Available parameter. In the example illustrated in FIG. 5, none of the associated VOIP networks can provide the required QOS. Therefore, the MSC may, at 48, route the call to a node in an alternative network such as the Public Switched Telephone Network (PSTN) instead of a VOIP network. Since one of the advantages of routing a call through a VOIP network is a lower charge for a long distance call, the subscriber may pay a higher rate since the call is routed through the PSTN. An appropriate rate must be determined, and the operator may provide the call at the VOIP network rate since the subscriber attempted the call through the VOIP network, but the VOIP network could not provide the service.

It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the system and method shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the scope of the invention as defined in the following claims.

WHAT IS CLAIMED IS:

1. A method of providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network, said method comprising the steps of:

sending an indication of the required QOS from the mobile network to the packet-switched network;

determining in the packet-switched network whether the required QOS can be provided; and

sending an indication that the required QOS can be provided from the packet-switched network to the mobile network, upon determining that the required QOS can be provided.

2. The method of providing a required QOS level of claim 1 further comprising sending an indication that the required QOS cannot be provided from the packet-switched network to the mobile network, upon determining that the required QOS cannot be provided.

3. The method of providing a required QOS level of claim 2 wherein the step of sending an indication that the required QOS cannot be provided includes sending an indication of a QOS level which can be provided.

4. The method of providing a required QOS level of claim 2 wherein the packet-switched network is a Voice-Over-Internet-Protocol (VOIP) network, and the step of sending an indication of the required QOS from the mobile network to the packet-switched network includes sending a message from a mobile switching center in the mobile network to a gateway in the VOIP network.

5. The method of providing a required QOS level of claim 4 wherein the step of sending a message from a mobile switching center in the mobile network to a gateway in the VOIP network includes sending an Initial Address Message (IAM) with

a QOS Required parameter.

6. The method of providing a required QOS level of claim 5 wherein the step of sending an IAM message with a QOS Required parameter includes sending a QOS Required parameter which includes required limits on latency, number of router hops, and bandwidth in the VOIP network.

7. The method of providing a required QOS level of claim 6 wherein the step of determining in the packet-switched network whether the required QOS can be provided includes determining from a gate keeper in the VOIP network whether the required limits on latency, number of router hops, and bandwidth can be met in the VOIP network.

8. The method of providing a required QOS level of claim 2 further comprising, after sending an indication to the mobile network that the required QOS cannot be provided, routing the call through an alternative network.

9. A system for providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network, said system comprising:

a mobile switching center that sends an indication of the required QOS from the mobile network to the packet-switched network;

means within the packet-switched network for determining whether the required QOS can be provided; and

a gateway in the packet-switched network that sends an indication to the mobile network of whether the required QOS can be provided.

10. The system for providing a required QOS level of claim 9 wherein the packet-switched network is a Voice-Over-Internet Protocol (VOIP) network, and the means for determining whether the required QOS can be provided includes a gate keeper that determines latency, number of router hops, and available bandwidth in the

VOIP network.

11. A method of providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network, said method comprising the steps of:

connecting a mobile switching center in the mobile network to a plurality of packet-switched networks;

simultaneously sending an indication of the required QOS from the mobile network to each of the plurality of packet-switched networks;

determining in each packet-switched network whether the required QOS can be provided;

sending an indication of whether the required QOS can be provided from each of the plurality of packet-switched networks to the mobile network;

determining in the mobile switching center whether any of the packet-switched networks can provide the required QOS; and

selecting by the mobile switching center, one of the plurality of packet-switched networks to route the call, upon determining that at least one of the packet-switched networks can provide the required QOS.

12. The method of providing a required QOS level of claim 11 wherein the step of selecting one of the plurality of packet-switched networks to route the call includes selecting the first packet-switched network that sends an indication that the required QOS can be provided.

13. The method of providing a required QOS level of claim 11 wherein the step of selecting one of the plurality of packet-switched networks to route the call includes the steps of:

determining a time period for receiving indications of whether the required QOS can be provided from each of the plurality of packet-switched networks; and

selecting a packet-switched network having a highest level of QOS received during the determined time period.

14. The method of providing a required QOS level of claim 11 further comprising, upon determining that none of the packet-switched networks can provide the required QOS, routing the call through an alternative network.

15. A method of providing a required quality of service (QOS) level for a call that is originated in a mobile radio telecommunications network and is routed through a packet-switched network, said method comprising the steps of:

(A) connecting a mobile switching center in the mobile network to a plurality of packet-switched networks;

(B) sending an indication of the required QOS from the mobile network to a selected packet-switched network;

(C) determining in the selected packet-switched network whether the required QOS can be provided;

(D) sending an indication of whether the required QOS can be provided from the selected packet-switched network to the mobile network;

(E) determining in the mobile switching center whether the selected packet-switched network can provide the required QOS;

(F) selecting another packet-switched network and repeating steps (A) through (E), upon determining that the selected packet-switched network cannot provide the required QOS; and

(G) routing the call to the selected packet-switched network, upon determining that the selected packet-switched network can provide the required QOS.

16. A method of accessing a packet-switched network from a mobile radio telecommunications network having a mobile switching center (MSC), said method comprising the steps of:

establishing a plurality of signaling connections between the MSC and a plurality of packet-switched networks;

sending a plurality of access messages from the MSC to the plurality of packet-switched networks;

sending an access response message from each of the plurality of packet-

switched networks to the MSC; and

selecting one of the responding packet-switched networks for access.

17. The method of accessing a packet-switched network from a mobile radio telecommunications network of claim 16 wherein the step of sending a plurality of access messages from the MSC to the plurality of packet-switched networks includes sending messages which include an indication of a required quality of service (QOS) level.

18. The method of accessing a packet-switched network from a mobile radio telecommunications network of claim 17 wherein the step of sending an access response message from each of the plurality of packet-switched networks to the MSC includes sending access response messages which include an indication of the QOS level which can be provided by each of the packet-switched networks.

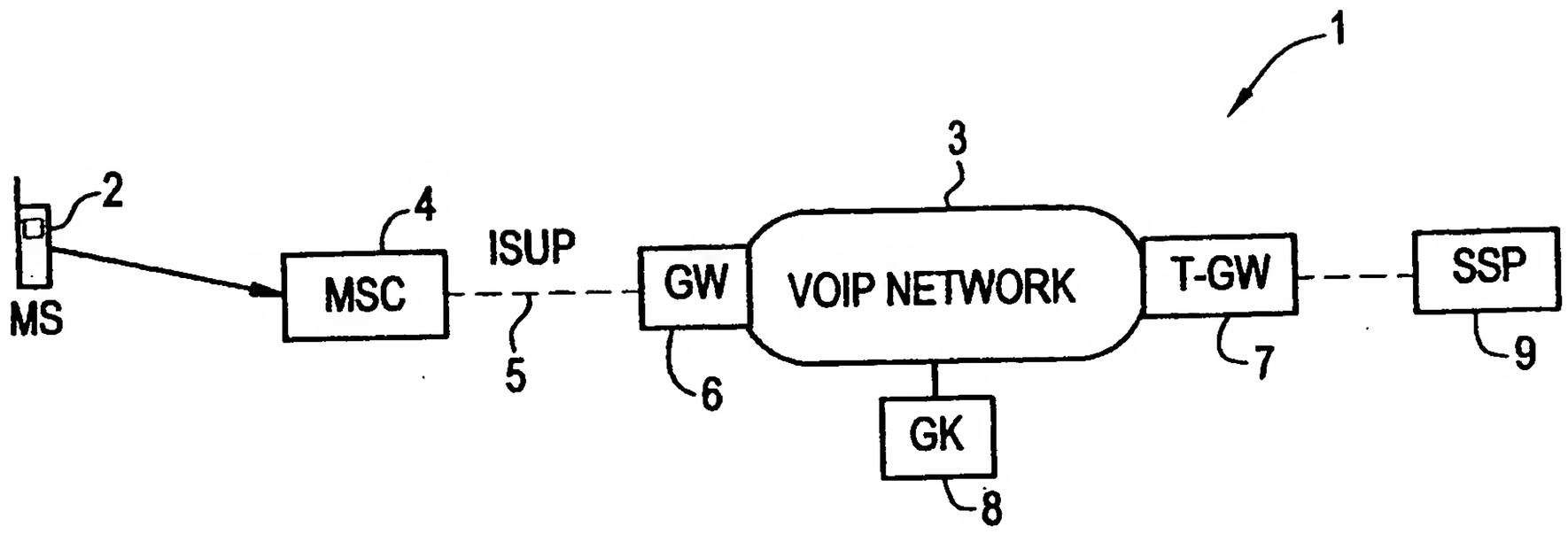
19. The method of accessing a packet-switched network from a mobile radio telecommunications network of claim 18 wherein the step of selecting one of the responding packet-switched networks for access includes selecting the first packet-switched network to respond with an indication that the required QOS level can be provided.

20. The method of accessing a packet-switched network from a mobile radio telecommunications network of claim 18 wherein the step of selecting one of the responding packet-switched networks for access includes the steps of:

determining a time period for receiving indications of whether the required QOS can be provided from each of the plurality of packet-switched networks; and

selecting a packet-switched network having a highest level of QOS received during the determined time period.

FIG.1


1
3
2
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4
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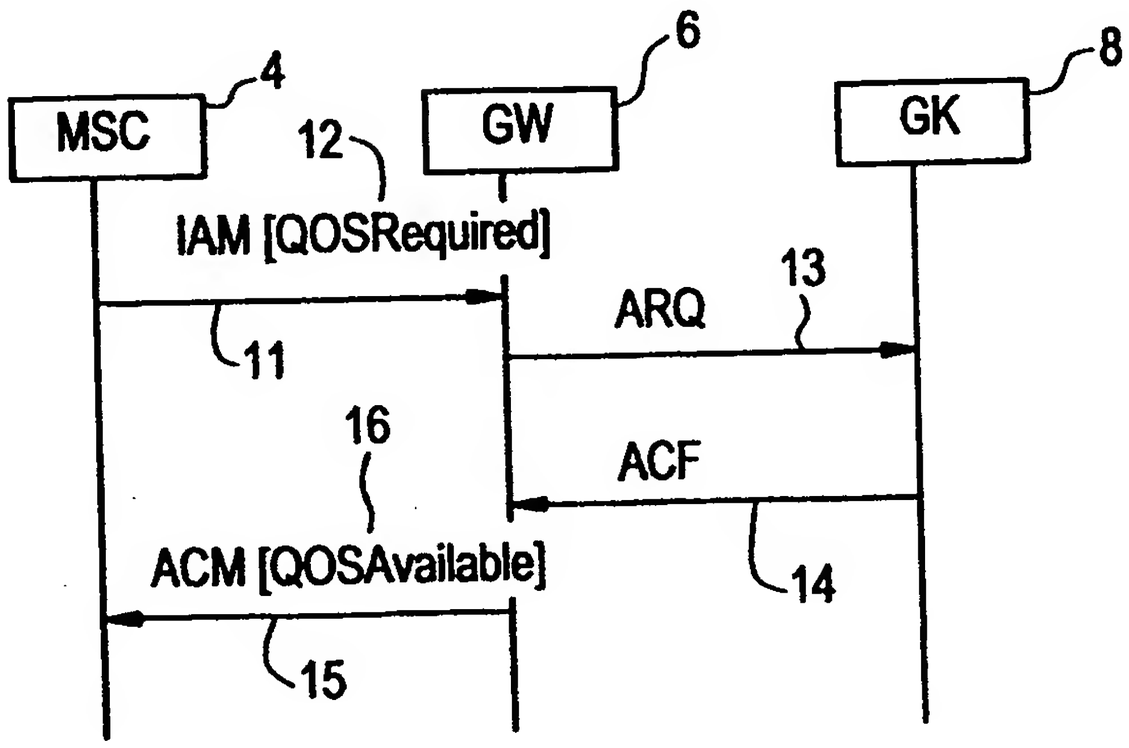
ISUP
5
GW
6
VOIP NETWORK
T-GW
7
SSP
9
GK
8

FIG.2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GW
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ARQ
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11
16
ACF
ACM [QOSAvailable]
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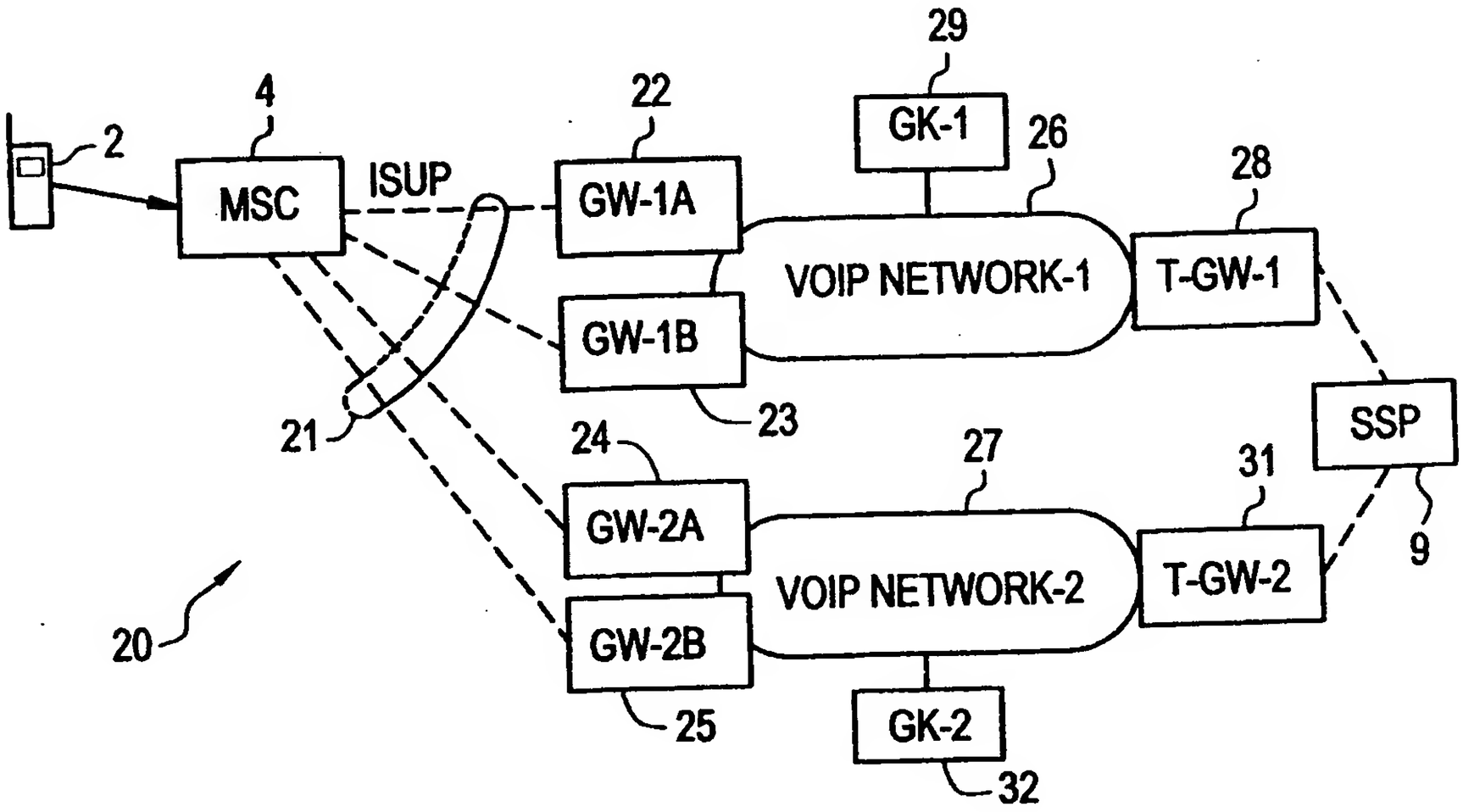
15

FIG.3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GK-1
26
28
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22
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ISUP
GW-1A
VOIP NETWORK-1
T-GW-1
GW-1B
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21
SSP
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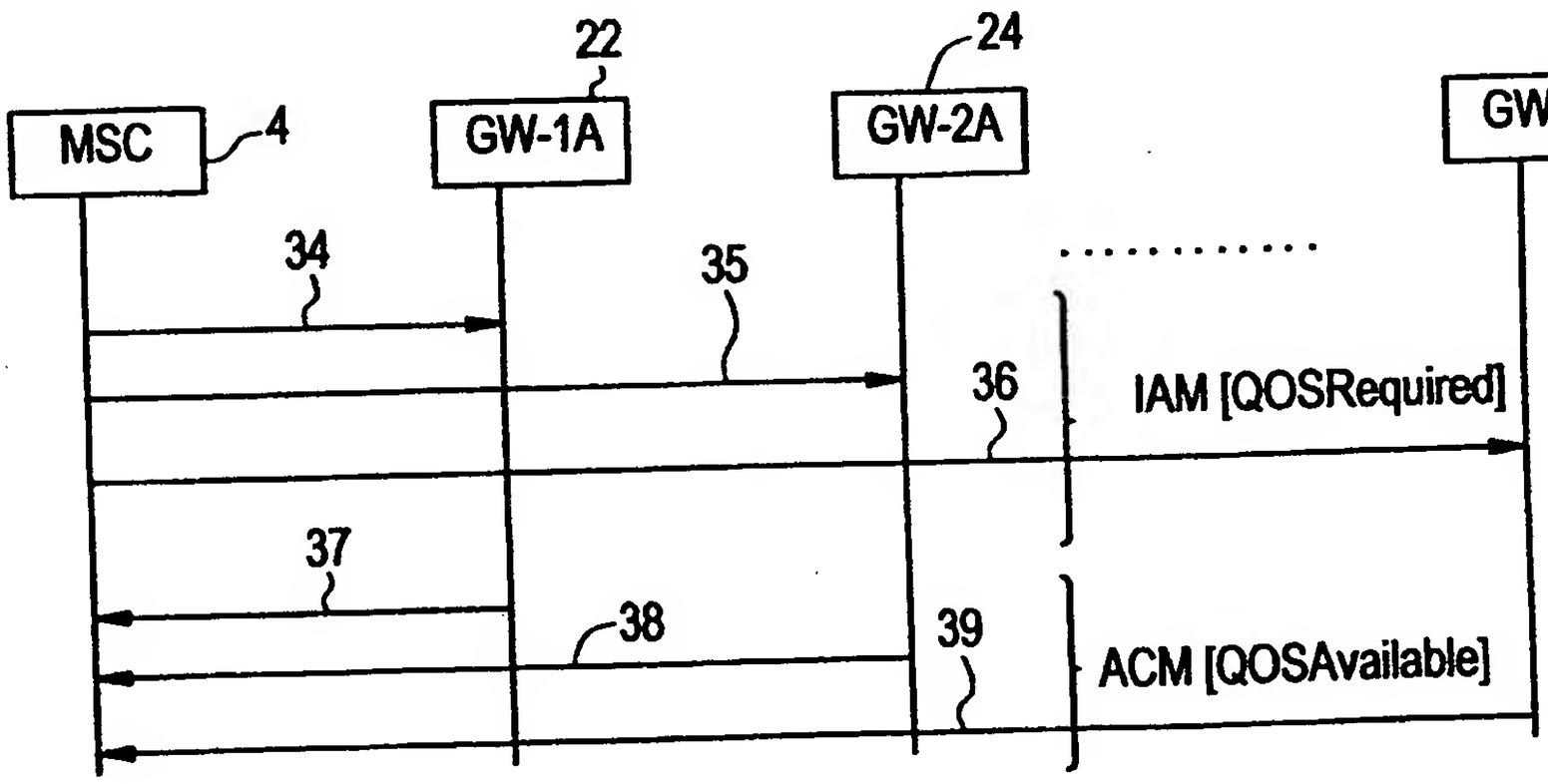
GW-2B
25
GK-2
32

FIG.4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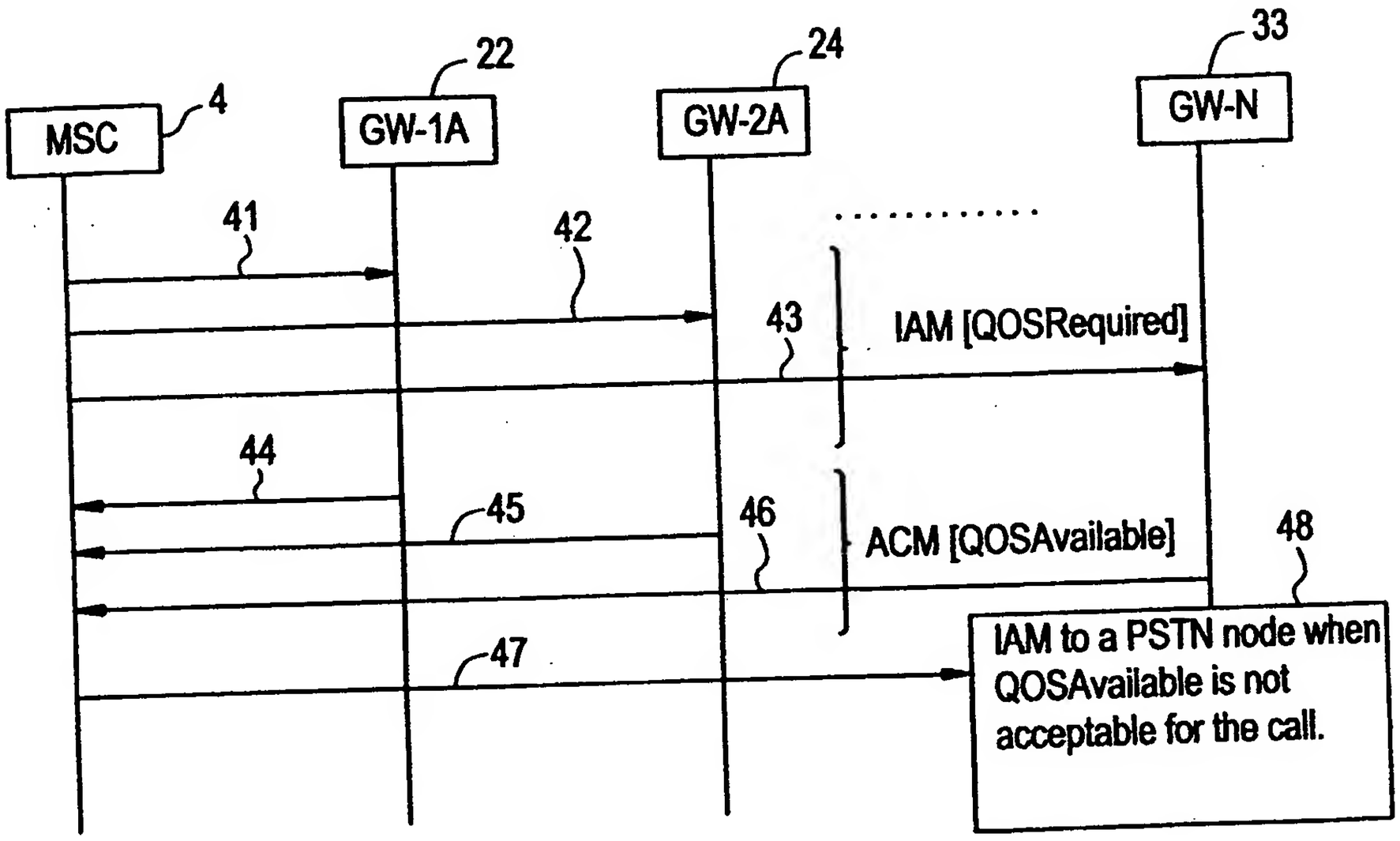
ACM [QOSAvailable]

FIG.5


MSC
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GW-1A
22
GW-2A
24
GW-N
33
41
42
43
IAM [QOSRequired]
44
45
46
ACM [QOSAvailable]
48
47
IAM to a PSTN node when QOSAvailable is not acceptable for the call.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01042

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/64, H04Q 7/22, H04Q 11/04, H04L 29/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04L, H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9916266 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 1 April 1999 (01.04.99), page 24, line 25 - page 29, line 5, figure 9, claims 1-19, 37-39, abstract	1-10,16
A	--	11-15,17-20
X	WO 9912329 A1 (BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY), 11 March 1999 (11.03.99), page 1, line 5 - page 3, line 22; page 14, line 15 - page 16, line 2; page 20, line 8 - page 21, line 10, claims 1-14, abstract	1-10,16
A	--	11-15,17-20

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 October 2000	14. 11. 2000
Name and mailing address of the International Searching Authority European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel(+31-70)340-2040, Tx 31 651 epo nl, Fax(+31-70)340-3018	Authorized officer Roger Bou Faisal/OGU Telephone No.

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International application No.
PCT/SE 00/01042

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A	WO 9736405 A1 (NOKIA TELECOMMUNICATIONS OY), 2 October 1997 (02.10.97), claims 1-20, abstract --	1-20
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Information on patent family members

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(51) INT CL[7]
H04M 7/00

(52) UK CL (Edition S)
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UK CL (Edition Q) H4K KOA
INT CL[6] H04M
ONLINE: WPI

(54) Abstract Title
IP telecommunications

(57) A telecommunications system comprises a signalling network and a Voice over IP (VoIP) network. The signalling network in turn comprises gateway signalling points 6,7 for converting signalling messages between at least two different signalling protocols. The IP network comprises IP nodes 4 for routing IP datagrams, with at least certain of the IP nodes 4 being co-located with respective gateway signalling points 6,7, and with the co-located signalling points 6,7 being arranged in use to pass routing information to the respective IP nodes 4 to enable those nodes to prioritise and route incoming IP datagrams.

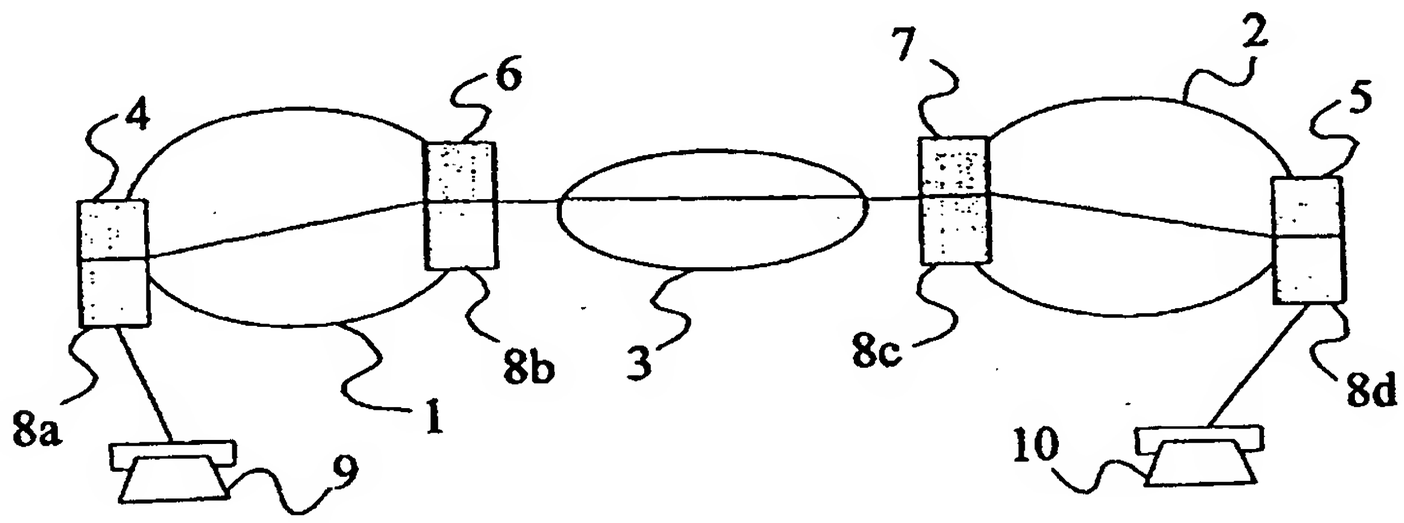

Figure 1

GB 2 352 111 A

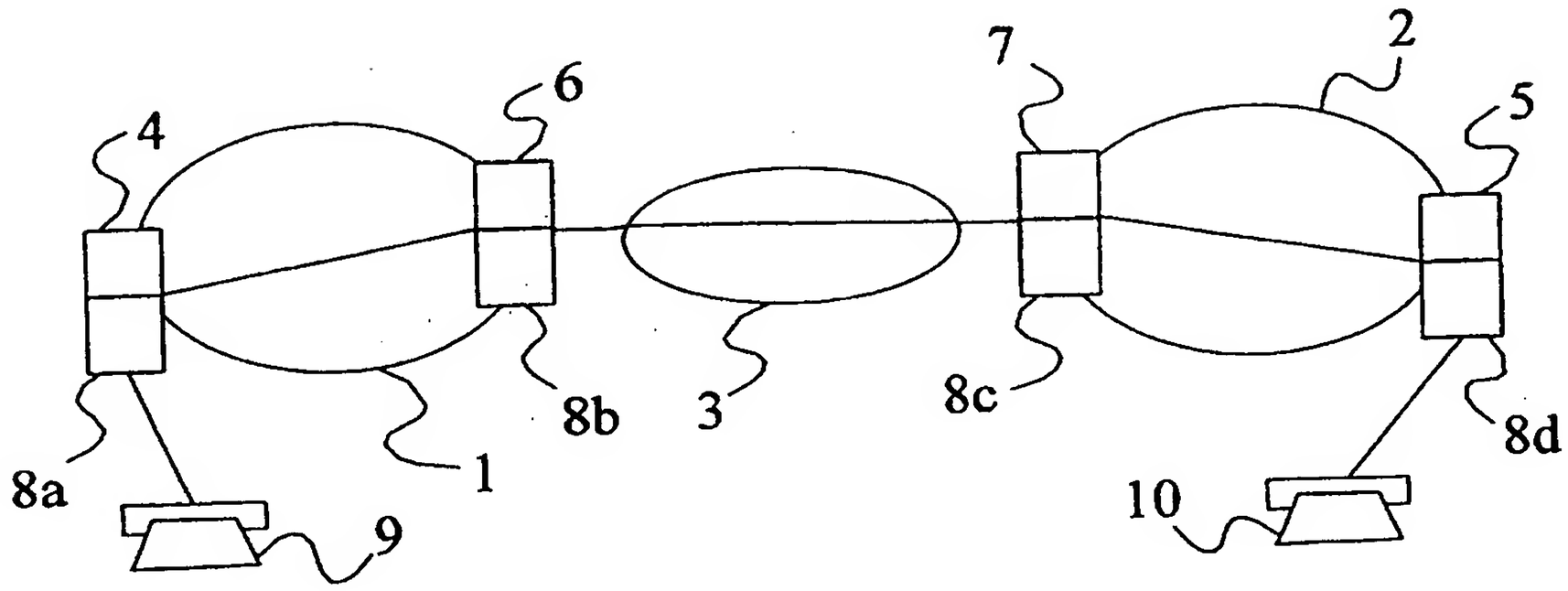

Figure 1

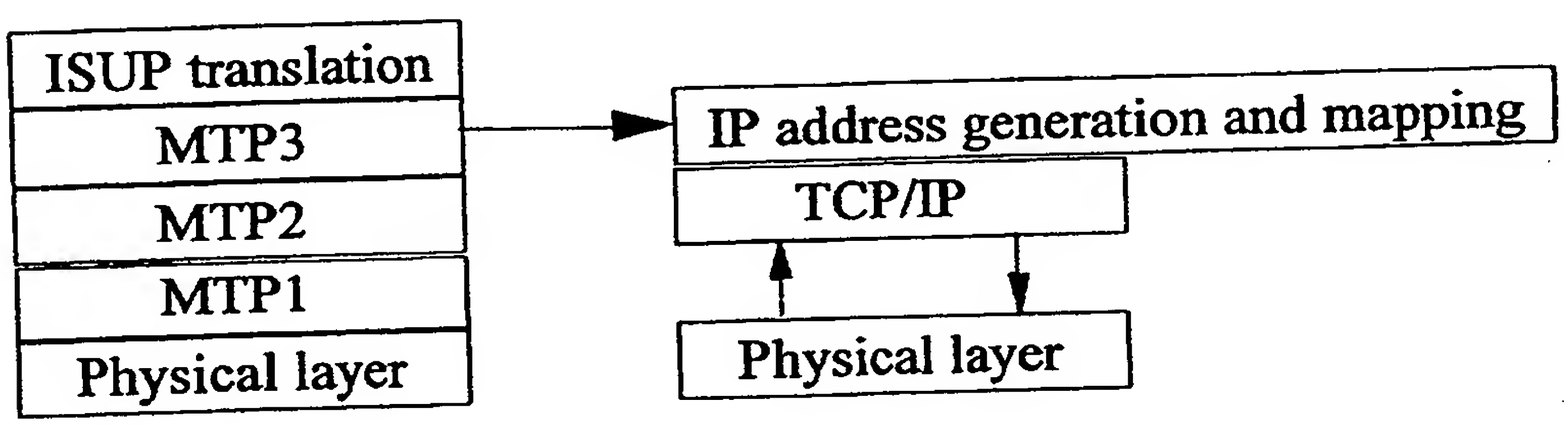

Figure 2

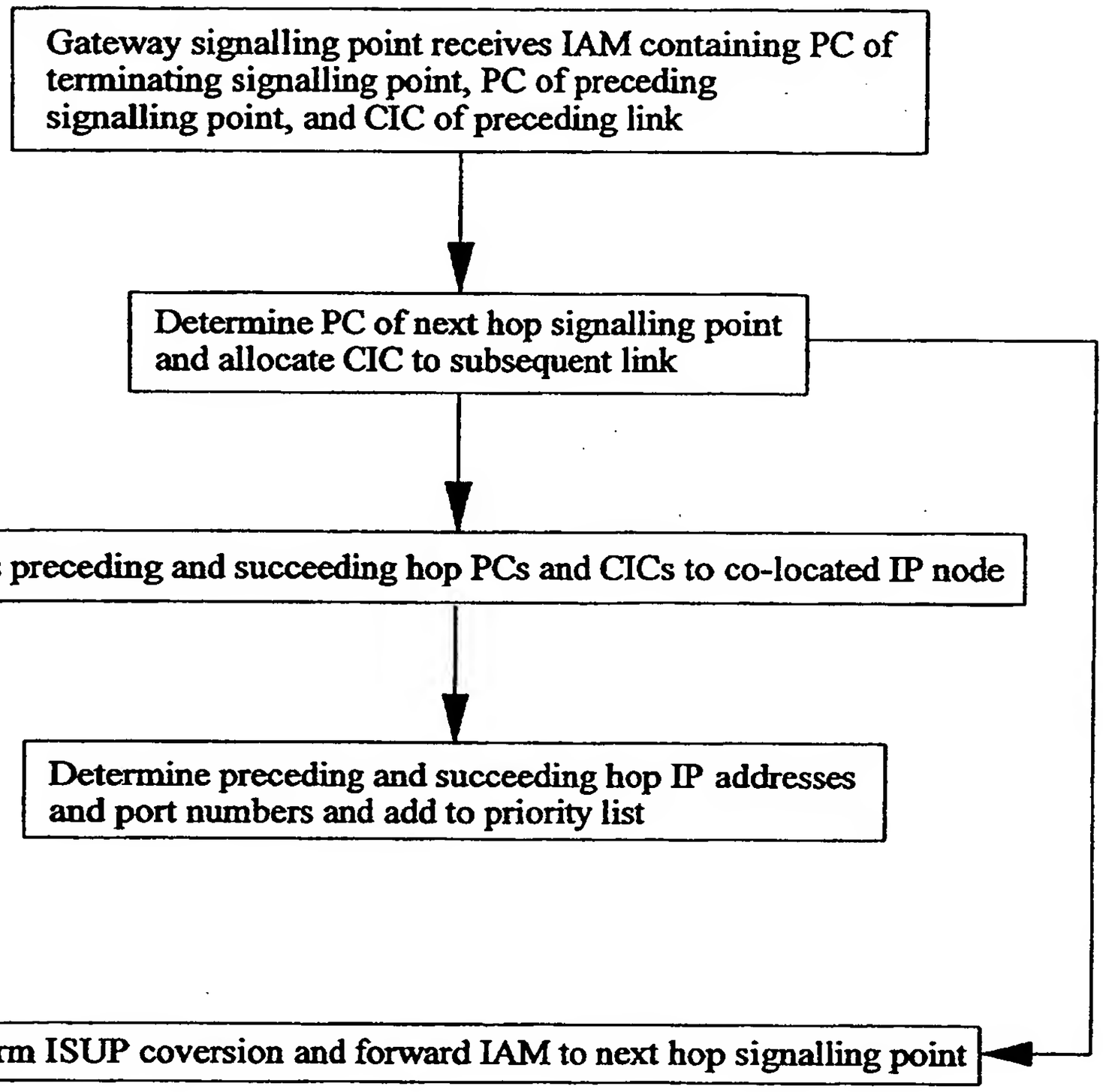
Gateway signalling point receives IAM containing PC of terminating signalling point, PC of preceding signalling point, and CIC of preceding link
Determine PC of next hop signalling point and allocate CIC to subsequent link
Pass preceding and succeeding hop PCs and CICs to co-located IP node
Determine preceding and succeeding hop IP addresses and port numbers and add to priority list
Perform ISUP coversion and forward IAM to next hop signalling point

Figure 3